LEARNING EXPERIENCE 2

EPIDEMIC!

PROLOGUE Even before John Snow made his methodical, scientific study of how cholera spread, people were aware that certain illnesses could be passed from one individual to another. Avoiding contact with sick people, fumigating homes where sickness had occurred, and burning bedding and clothing of sick individuals were common practices. In this learning experience, you will be examining the many ways that diseases can be transmitted; you will then determine what, if anything, can be done to break the chain of transmission.

THE END OF THE WORLD IS NIGH

READING

The various outbreaks of cholera in London and other cities such as New York and Boston during the 1800s are examples of a phenomenon known as an epidemic. An outbreak of a disease is considered an epidemic when it is prevalent and spreads rapidly among many individuals in a community at the same time. Epidemics of a disease that occur simultaneously around the world are considered pandemics. Epidemics and pandemics are part of life and of history. Some examples of these, past and present, are shown in Table 2.2 on the following page.

Since Snow's time, epidemiologists (individuals who study the pattern and occurrence of outbreaks of disease) and other scientists have determined that disease can be carried from one individual to another by a variety of methods, called *modes of transmission*. These include spread resulting from direct, person-to-person contact or touching; from contaminated water and food (as Snow determined); through the air; and through the saliva or feces of insects or other animals (called *vectors*). With the knowledge of how a disease is transmitted (communicated), perhaps measures can be taken to reduce its spread or to avoid it ourselves.

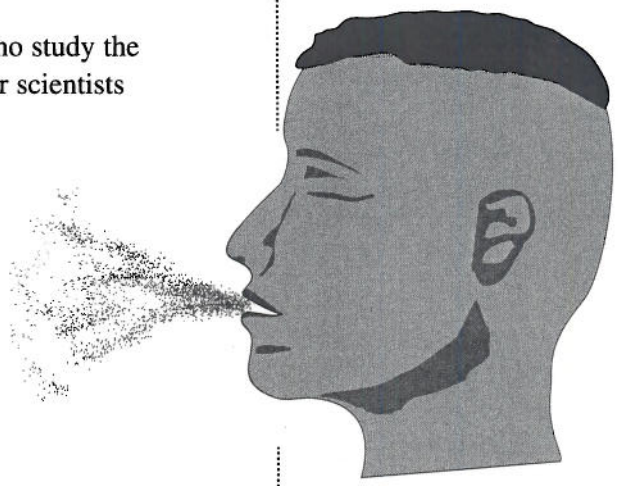

Figure 2.1
Diseases such as a cold may be spread when saliva droplets are sprayed into the air during a sneeze.

In general, specific diseases are spread by only one mode of transmission; for example, flu is spread when saliva from an infected person is sprayed into the air during a sneeze and is considered an airborne disease. Table 2.2 indicates how certain diseases are spread.

Table 2.2
Epidemics and pandemics through history

DISEASE	MODE OF TRANSMISSION	LOCATION/DATE (A.D.)	INFECTION RATE AND/OR DEATH TOLL
smallpox	direct contact	Roman Empire (165–180)	25%–35% of population affected
bubonic plague	fleas on rats (vector)	Europe (1347–1350)	17–28 million deaths; 33%–50% of population affected
influenza	airborne	worldwide (1918–1919)	2 million deaths
polio	contaminated water	U.S. (1943–1956)	22,000 deaths; 400,000 affected
tuberculosis	airborne	worldwide (ongoing)	500,000 deaths annually
diarrheal diseases (primarily enteric (intestinal) bacteria and rotavirus)	contaminated food and water	developing countries (South America, Africa, Asia) (ongoing)	10 million deaths annually
malaria	mosquitoes	developing countries (South America, Africa, Asia) (ongoing)	1.2 million deaths annually
AIDS	direct contact	worldwide (ongoing)	25–30 million reported infections

ANALYSIS

In preparation for a discussion, write responses to these questions in your notebook.

1. How do modes of transmission of the infectious diseases listed in Table 2.2 differ?
2. Through what kinds of activities might individuals come in contact with each of these diseases?
3. What are ways people might try to avoid contracting these diseases?
4. List any infectious and noninfectious diseases that have occurred in your community during the past year. For each one, describe how you think it was communicated (transmitted).

ACTIVITY

OUTBREAK

INTRODUCTION In this investigation, you will participate in an epidemic without suffering any dire consequences. You will spread an "infection" by using one mode of transmission—direct contact. Then, using a standard technique in the field of microbiology (the study of microorganisms), you will be able to "diagnose" the presence of the infection and discover who has been "infected." As you analyze

your data, think about the kinds of preventative measures that might be used to halt the spread of this infection.

MATERIALS NEEDED

For each student:

- 1 pair of safety goggles
- 1 sterile cotton swab or inoculating loop
- 1 nutrient agar plate

For each group of eight students:

- 1 piece of contaminated candy (hard candy)
- 1 wax marking pencil (grease pencil)
- 1 test tube containing nutrient broth

For the class:

- soap, detergent, or disinfectant
- warm water
- 4 sponges
- yeast solution
- sterilized tweezers or tongs

PROCEDURE

1. Count off within your group and write your number on an agar plate.
2. Wash your hands thoroughly. ***NOTE:*** When working with microorganisms, certain practices should be followed in order to ensure that the materials you are working with do not become contaminated with microorganisms present in the air, on your hands and clothing, and on working surfaces. These practices are known as *sterile* or *aseptic* techniques. Sterile techniques also protect the investigator from becoming contaminated by the materials he/she is working with. Although all of the organisms you will be working with are harmless, sterile techniques should still be used. These include:
   - Wash hands thoroughly with soap and water before starting and at the conclusion of the experiment;
   - Wash the laboratory table with disinfectant or detergent before and after the experiment;
   - Use sterile media, glassware, and tools;
   - Keep hands away from working ends of tools (such as inoculating loops, cotton swabs, and tweezers) and glassware. Do not touch the insides of agar plates;
   - Keep bottles, tubes, and flasks covered when not in use;
   - Do not mouth pipette;
   - Do not eat, drink, or smoke in the work area.

SAFETY NOTE: *Always wear safety goggles when conducting experiments.*

3. If your number is 1, the instructor will give you a piece of candy soaked in the "contaminant," a yeast solution (a benign fungus). Roll it around in your right hand until your palm and fingers are very sticky. Put the candy in the disposal area designated by the instructor.
4. Shake hands with student number 2 in your group. Student 2 shakes hands with student 3, and so on, until *all but the last person* in the group has had a handshake.
5. Take a sterile cotton swab or inoculating loop, dip the cotton or loop end in the nutrient broth in the test tube, then swab your right hand with it. Carefully open your agar plate and gently rub the loop or streak the swab across the surface of the agar. Do not press too hard. Roll the tip as you streak to transfer as much of the material gathered from your hand as possible to the agar. Swab in a zigzag pattern as shown in Figure 2.3. Place the swab or loop in the area designated for disposal or clean-up.

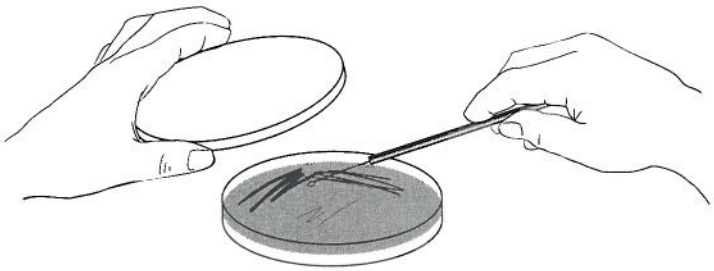

Figure 2.3
Streaking a plate

6. Cover the agar plate, turn it upside down (that is, agar side up), and store it at room temperature (approximately 25°C) to incubate for 24 hours.
7. Wash your hands thoroughly, then rinse with a dilute solution of disinfectant, if available.
8. STOP & THINK In your notebook, write a prediction of the results of this investigation.
9. After 24 hours of incubation, examine your plate and those of others in your group. Record whether or not there is growth on each of the plates.

ANALYSIS

Write responses to the following questions in your notebook.

1. Which plate or plates have the most growth? The least? Make a chart showing the range of growth on plates from your group.

2. Did the results agree with your prediction? If not, why do you think they differed?
3. Why was the last person in your group instructed not to shake hands with anyone? How is that person's plate different from the others?
4. What might these results tell you about the spread of infectious disease?
5. What approaches can you think of to stop the spread of this classroom infection? Design an experiment that would prove that one of these approaches has stopped the spread. In your design be sure to include:
   - the question(s) being asked;
   - the hypothesis;
   - your predictions about the experimental results;
   - the experimental procedure you would use;
   - the method for data collection.
6. What might your experiment tell you about the possibility of reducing disease transmission in everyday life?
7. Do you think there is a danger in shaking hands with someone with smallpox? cholera? malaria? cancer? a genetic disease such as cystic fibrosis? Why or why not?
8. Read the article "U. S. Cholera Cases Set Record in 1992" on the following page. Based on the article and your knowledge, why do you think the admonition to "boil it, cook it, peel it or forget it" is good advice?
9. How might an airline learn more about infectious diseases that might be present in their route countries? What precautions might the airline take if they knew that cholera was present?

U.S. Cholera Cases Set Record in 1992

OUTBREAK FROM SINGLE FLIGHT ACCOUNTED FOR 75 OF 96 INCIDENTS OF ILLNESS

New York Times, September 11, 1992

ATLANTA, Sept. 10 (AP)—A cholera outbreak aboard an Argentine airplane bound for Los Angeles helped push the number of travel-related cholera cases in the United States to an all-time high, Federal health officials said today.

The airplane cases resulted from a cholera outbreak that began in Peru in 1991 and has now spread to Mexico and the Caribbean, resulting in 5,000 deaths along the way, the Federal Centers for Disease Control reported.

Cholera is a severe diarrhea that can be accompanied by vomiting and dehydration. It is caused by contaminated foods and water, and can be fatal in cases of extreme dehydration. The centers said that 96 cholera cases had been reported in the United States since January and that 95 of those were travel related. The cause of the remaining case is unknown.

OUTBREAK FROM FLIGHT

The number of cases this year is higher than in any year since the Federal agency began monitoring cholera in 1961. In the 20 years through 1981, only 10 cholera cases were reported in the United States, the agency reported.

The bulk of this year's cases resulted in February from a cholera outbreak aboard an Aerolineas Argentinas flight from Argentina to Los Angeles. Seventy-five passengers developed cholera from a seafood salad served during the flight. Most of the remaining cases involved Americans traveling to Latin America or Asia to visit relatives, the agency reported.

Travelers should avoid drinking water that has not been boiled and avoid eating raw seafood, raw vegetables and food or drinks sold by street vendors, said Dr. Jessica Tuttle, a medical epidemiologist for the centers. She said the agency recommended that travelers follow a general rule of "boil it, cook it, peel it or forget it."

The centers also recommended that airlines traveling to and from cholera-affected areas be equipped with special medicine to treat cholera patients.

The agency also reported today that the 1991 cholera outbreak in Latin America had now spread to Mexico and the Caribbean. More than 600,000 cholera cases and 5,000 deaths have been attributed to the outbreak through Aug. 26, the centers said. . .

EXTENDING IDEAS

- Analyze why and how prevention measures do or do not work. Trace the history of the treatment and prevention of diseases such as: measles, bubonic plague, hepatitis, diphtheria, the common cold, polio, smallpox, rabies, Lyme disease, herpes, tuberculosis, malaria, influenza, or AIDS and explain why methods of stopping the spread of the diseases succeeded or failed.

- The bubonic plague, or Black Death, originated in the Far East and spread west to Europe during the 1300s through shipping trade routes. These ships brought plague-ridden rats and infected seafarers to seaport cities. The symptoms of the plague included swelling of the lymph glands, pain, fever, and coughing up of blood. All of these preceded a painful death. Affected cities were filled with the unbearable stench exuding from bodies of the dead and dying. The nursery rhyme

  Ring a ring of rosies, a pocket full of posies
  A-tichoo, a-tichoo, we all fall down

  describes some of the symptoms and treatments of the time. Determine the trade routes during this period of time and how the path of the pandemic followed these routes. Explain how conditions during this time facilitated the spread of the disease, the nature of the treatments available to people, and what finally ended the pandemic.

- The course of history has been shaped by the occurrence of disease. Smallpox facilitated the Spanish conquest of America; Charlemagne's conquest of Europe in 876 A.D. was slowed by an epidemic of influenza which claimed much of his army; schistosomiasis is one of the reasons Taiwan is not part of mainland China today. Research one of these or other epidemics that have played a role in historical events.

- Are family pets factors in the transmission of diseases to humans? Is this a significant route of disease transmission? What precautions, if any, should pet owners take? Analyze local, regional, or state statistics to help answer the questions.

- Public health is a field that addresses the problem of disease prevention by studying conditions of environment, culture, and society that affect the health of a group of people. Call your nearest state public health office and interview a public health officer about his or her job.

ON THE JOB

PUBLIC HEALTH MICROBIOLOGIST Does the seemingly invisible world which appears under a microscope fascinate you? Public health microbiologists are scientists who study microscopic life and the role of bacteria which cause disease by affecting the water or food supply or the general environment. They identify ways to control or eliminate sources of possible pollution or contagion. Microbiologists investigate disease-causing organisms in order to learn how the organism causes the disease. A microbiologist might count bacteria in a water supply and analyze sewage samples for harmful microorganisms. The laboratory techniques and procedures used by a microbiologist are not unique to microbiology, but are the techniques and equipment of chemists, geneticists, ecologists, or physiologists. With a four year college degree, positions as laboratory assistants, clinical or research microbiologists are possible. With a master's degree or doctoral degree, microbiologists can teach in a university or pursue independent research. Classes such as biology, chemistry, physics, mathematics, computer science, and English are necessary.

PUBLIC HEALTH SERVICE OFFICER Are you interested in advocating for public health standards in your community? Public health service officers work with local communities, cities, states and federal or other authorities to advocate for the public health safety of a county or city. They may inspect facilities to ensure that public health standards are maintained, or to identify health hazards, assist in establishing clinics or other programs to improve public health, as well as to develop and coordinate public relations campaigns in order to promote services and programs within a community. They may also impose quarantines on specific areas, animals or persons known to be carrying contagious diseases, or prohibit the sale of unsafe food products or close establishments not meeting public health standards. Public health service officers have a four year college degree. Classes such as biology, chemistry, mathematics, computer science, and English are recommended.